Quarterly Report

Covering 1 January 1966 to 31 March 1966

For Purchase Request R-36-011-014 (Contract AF33(615)-3583)
Entitled, "Design of Experimental Liquid Oxygen Converter"

1. The initial efforts on this program which are being investigated concurrently by the contractor are as follows:

a. Power Converter Design
b. Electrode Construction
c. Design Optimization
d. Shape Study
e. Liquid Analog Investigation
f. Transparent Tank Fabrication
g. Hazard Analysis

2. Power Converter - The specification of components for the breadboard power converter is complete and components have been ordered. This includes the design of special high voltage transformers. The power supply to be constructed is a laboratory breadboard model but efforts are being made to minimize its size and weight. State of the art components are to be used whenever possible. The following set of specifications has been selected for the breadboard power supply:

Output	= 20-100 kilovolts
Frequency	= 1/100 cps
Charging Power	= 2 watts
Waveform	= square wave
Rise Time	= less than 2 seconds
Decay Time	= less than 2 seconds

Input	
Voltage	= 28v DC (battery)
Power	= approximately 30 watts

3. Electrode Construction - The electrode evaluation program requires that electrodes be constructed for three different purposes.

a. Electrodes for Analog Testing
b. Electrodes for Vibration and Centrifuge Testing
c. Electrodes for Flight Testing

For the analog testing there is no strength requirement. Electrodes have been fabricated by using brass screens with rims soft soldered in place.

To achieve stronger electrodes for vibration testings several samples have been made by various techniques using silver solder to join the screens to the rims.

Two screen manufacturers have been visited by the contractor and prototype construction of electrodes have been discussed. Aluminum rims crimped to the screen edges appear to offer the most promise. Electrodes for flight testing and possibly for vibration and centrifuge testing may be supplied by one of those vendors. Dynatech is also planning to use perforated sheet metal to construct experimental electrodes. This material while heavier than screen may lend itself to a simpler and lighter method of support.

4. Design Optimization - Early preliminary design optimization have been undertaken to help in the design of both the tank electrode assemblies and the power supply. Studies show that for small tanks the optimum voltage will be lower than for the large tanks. The breadboard model power converter will be adjustable over the voltage range of interest, that is 10-100 kilovolts.

5. Shape Study - An investigation has been undertaken which compares the various possible storage tank shapes and electrode configurations for dioelectrophoretic fluid orientation systems. This study will relate fluid orientation capability with weight for the various tank shapes of interest. Shapes being considered are the sphere, cone, cylinder, and toroid.

6. Liquid Analog Investigations - Liquid analog investigations have been initiated by first reviewing reports and films obtained from previous programs at Dynatech. A spherical array of electrodes has been constructed by techniques mentioned above and will shortly undergo initial test evaluation in a transparent plexiglass tank. A number of fluid orientation techniques have been proposed and will be systematically investigated using the laboratory analog technique.

7. Transparent Tank Fabrication - Fluid orientation tests will require the use of transparent tanks. Plastic tanks are favored since they are less expensive and more rugged than glass. It will be necessary to achieve an electrically conducting surface on the inside of the tanks to simulate the electrical properties of the final metal oxygen converter. While no solutions are currently in hand for coating plastics with a conducting transparent surface, a number of very promising leads have been uncovered and are being pursued.

8. Hazard Analysis - The initial effort currently being pursued is a comprehensive literature search of hazards associated with liquid oxygen systems. Preliminary findings indicate that there is a great deal of data related to the oxidation of various organic structural materials in the presence of liquid oxygen. The one plastic material which has been found to be safe in the presence of liquid oxygen is teflon. No data has

been uncovered indicating the effect of sparks on promoting chemical reactions between liquid oxygen and other materials. Ceramics would appear to be the most promising from the hazard point of view. However, the use of ceramics for electrical insulation and structural support of the electrode array would provide a more difficult design problem than the use of structural plastics due to the brittleness of ceramics.

9. Flight Test Program - A preliminary flight test plan has been prepared and coordinated with the contractor. It is anticipated that these tests will take place during January and February of 1967 at Wright-Patterson AFB. Initial contact is being made with the flight test group at Wright-Patterson AFB in order to plan and finalize early planning of this expeiment.

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